AMENDMENTS TO THE CLAIMS

1. (previously presented) An image processing apparatus comprising:

gradient calculation means for calculating at least the direction of the level gradient of each of a plurality of processing units in a given image data including a plurality of pixels, the pixels respectively having level data;

line segment formation means for producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a given length and a direction corresponding to the direction of each level gradient which is calculated by said gradient calculation means; and

line segment image storage means for storing the line segment image data produced by said line segment formation means.

2. (original) The image processing apparatus according to claim 1, further comprising

image storage means for storing said given image data.

3. (previously presented) The image processing apparatus according to claim 1, further comprising

image data extraction means for extracting image data in a processing region set in input image data and feeding the extracted image data to said gradient calculation means.

4. (original) The image processing apparatus according to claim 3, further comprising means for setting said processing region.

5. (previously presented) The image processing apparatus according to claim 1, wherein said line segment formation means produces line segment image data at a gray level.

6. (previously presented) The image processing apparatus according to claim 1, wherein

said line segment formation means produces line segment image data at a binary level.

7. (previously presented) The image processing apparatus according to claim 1, wherein

said gradient calculation means calculates the magnitude of the level gradient in addition to the direction of the level gradient.

8. (previously presented) The image processing apparatus according to claim 1, wherein

said gradient calculation means calculates the magnitude of the level gradient in addition to the direction of the level gradient, and

said line segment formation means produces line segment image data having a level corresponding to the magnitude of the level gradient which is calculated by said gradient calculation means.

9. (previously presented) The image processing apparatus according to claim 1, wherein

said gradient calculation means calculates the magnitude of the level gradient in addition to the direction of the level gradient, and

said line segment formation means produces line segment image data only when the magnitude of the level gradient which is calculated by said gradient calculation means is not less than a predetermined threshold.

10. (previously presented) The image processing apparatus according to claim 1, wherein

said line segment image storage means adds new line segment image data to line segment image data already stored at each of the pixels, and stores the result of the addition.

11. (previously presented) The image processing apparatus according to claim 1, wherein

said line segment image storage means stores new line segment image data without subjecting the line segment image data to addition processing.

12. (previously presented) The image processing apparatus according to claim 1, wherein

said line segment formation means produces a line segment having a predetermined length in a direction corresponding to the calculated direction of the level gradient from the position of the processing unit.

13. (previously presented) The image processing apparatus according to claim 1, wherein

said line segment formation means produces, when the distance from the position of the processing unit to an initial point and the distance from the processing unit to an initial point and the distance from the processing unit to a terminal point are specified, a line segment from said initial point to said terminal point in a direction corresponding to the calculated direction of the level gradient.

14. (original) The image processing apparatus according to claim 12, further comprising

means for setting the length of the line segment.

15. (original) The image processing apparatus according to claim 13, further comprising

means for setting at least one of the distance from the processing unit to the initial point and the distance from the processing unit to the terminal point.

16. (previously presented) The image processing apparatus according to claim 1, further comprising

means for detecting a portion where line segments represented by the line segment image data stored in said line segment image storage means are concentrated.

17. (previously presented) The image processing apparatus according to claim 1, further comprising

means for detecting the position of the pixel having the maximum of the levels of the line segment image data stored in said line segment image storing means.

18. (original) The image processing apparatus according to claim 17, further comprising

means for judging whether or not said maximum level exceeds a predetermined threshold.

19. (previously presented) The image processing apparatus according to claim 1, further comprising

image input means having a camera for producing image data and feeding the produced image data to said gradient calculation means.

20. (previously presented) The image processing apparatus according to claim 1, further comprising

a display device for displaying a line segment image represented by the line segment image data produced by said line segment formation means or the line segment image data stored in said line segment image storage means.

21. (original) The image processing apparatus according to claim 20, wherein

said display device displays an image represented by said given image data with the image overlapped with said line segment image.

22. (original) The image processing apparatus according to claim 20 further comprising

means for extracting an edge of the image represented by said given image data,

said display device displaying an image represented by the extracted edge with the image overlapped with said line segment image.

23. (original) The image processing apparatus according to claim 16, further comprising

a display device for displaying a mark representing the portion, where the line segments are concentrated, detected by said detection means with the mark overlapped with the image represented by said image data.

24. (original) The image processing apparatus according to claim 17, further comprising

a display device for displaying, at the position of the pixel having the maximum level which is detected by said detection means, a mark indicating that the pixel has the maximum level with the mark overlapped with the image represented by said image data.

25. (original) The image processing apparatus according to claim 18, further comprising

a display device for displaying, at the position of a pixel having the maximum level which is judged to exceed a threshold by said judgment means, a mark indicating that the pixel has the maximum level with the mark overlapped with the image represented by said image data.

26. (previously presented) The image processing apparatus according to claim 23, further comprising

means for extracting an edge of the image represented by said image data,

said display device displaying an image represented by the edge extracted by said edge extraction means in addition to or in place of the image represented by said image data.

27. (original) The image processing apparatus according to claim 26, wherein

said display device displays the line segment image represented by said line segment image data with the line segment image further overlapped with the image represented by the edge.

28. (previously presented) An image processing apparatus comprising:

an image processing means for calculating at least the direction of the level gradient of each of a plurality of processing units in given image data, and producing line segment data representing a line segment for each of the plurality of processing units, each line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each image data having a non-zero level gradient; and

display means for displaying the line segment images represented by the line segment image data produced by said image processing means.

29. (original) The image processing apparatus according to claim 28, wherein

said display device displays the image represented by said image data with the image overlapped with said line segment image.

30. (original) The image processing apparatus according to claim 29, further comprising

means for extracting an edge of the image represented by said image data,

said display device displaying an image represented by the edge extracted by said edge extraction means in addition to or in place of the image represented by said image data.

31. (previously presented) An image processing method comprising the steps of:

calculating at least the direction of the level gradient of each of a plurality of processing units in given image data including a plurality of pixels, the pixels respectively having level data;

producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each pixel having a non-zero level gradient; and

storing the produced line segment image data in storage means.

32. (previously presented) A medium storing a program for controlling a computer so as to:

calculate at least the direction of the level gradient of each of a plurality of processing units in given image data including a plurality of pixels, the pixels respectively having level data;

produce line segment image data representing a line segment for each of the plurality of processing units, each line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each pixel having a non-zero level gradient; and

store the produced line segment image data in storage means.

33. (previously presented) An image processing method comprising:

calculating at least the direction of the level gradient of each of a plurality of processing units in given image data;

producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each image data having a non-zero level gradient; and

displaying line segment images represented by the produced line segment image data on a display device.

34. (previously presented) A medium storing a program for controlling a computer so as to:

calculate at least the direction of the level gradient for each of a plurality of processing units in given image data, and produce line segment image data representing a line segment for each of the plurality of processing units, each line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each processing unit having a non-zero level gradient; and

display line segment images represented by the produced line segment image data on a display device.

35. (previously presented) An image processing apparatus comprising:

means for extracting a plurality of edges whose level gradients are not less than a predetermined value in given image data;

means for setting, for each of the edges, a line segment extending a predetermined length in a direction corresponding to the direction of the extracted edge; and

means for detecting the presence or absence of a point of intersection of a plurality of line segments and the position thereof.

36. (original) The image processing apparatus according to claim 35, wherein

the direction of the line segment is a direction perpendicular to the direction of the edge or the same direction as the direction of the edge.

37. (currently amended) An inspection apparatus comprising:

image input means for inputting image data representing an inspection object;

means for calculating at least the direction of the level gradient of each of a plurality of processing units in said input image data, and producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a specified length and a direction corresponding to the calculated direction of the level gradient; and

means for detecting the presence or absence of a portion where the line segments are concentrated or are overlapped with one another and the position thereof on the basis of the produced line segment image data.

38. (original) The inspection apparatus according to claim 37, wherein

the direction corresponding to the direction of said level gradient is the direction of the level gradient or a direction perpendicular to the direction of the level gradient.

39. (original) The inspection apparatus according to claim 38, further comprising

a display device for displaying the line segment image on the basis of said line segment image data.

40. (original) The inspection apparatus according to claim 39, wherein

said display device displays an image of the object represented by said input image data with the image overlapped with the line segment image.

41. (previously presented) The inspection apparatus according to claim 37, further comprising

a display device for displaying the detected position of the portion where the line segment images are concentrated or are overlapped with one another on the image of the object represented by said input image data or an image represented by an edge extracted from said input image data.

42. (previously presented) The inspection apparatus according to claim 37, further comprising

means for inputting data relating to the length of the line segment or the initial point and the terminal point of the line segment.

43. (previously presented) The image processing apparatus according to claim 1, wherein the direction of the level gradient is a direction of a composite vector of a vector

having a level gradient along the X axis and a vector having a level gradient along the Y axis.

44. (previously presented) The image processing apparatus according to claim 28, wherein the direction of the level gradient is a direction of a composite vector of a vector having a level gradient along the X axis and a vector having a level gradient along the Y axis.

45. (previously presented) The image processing apparatus according to claim 35, wherein the direction of the level gradient is a direction of a composite vector of a vector having a level gradient along the X axis and a vector having a level gradient along the Y axis.

46. (previously presented) The image processing apparatus according to claim 37, wherein the direction of the level gradient is a direction of a composite vector of a vector having a level gradient along the X axis and a vector having a level gradient along the Y axis.

47. (previously presented) The image processing apparatus according to claim 1, further comprising line segment image processing means for processing line segment image data stored in the line segment image storage means.

48. (previously presented) An image processing apparatus comprising:

a gradient calculator which calculates at least the direction of the level gradient of a processing unit in a given image data including a plurality of pixels, the pixels respectively having level data;

a line segment former which produces line segment image data representing a line segment having a given length and a direction corresponding to the direction of the level gradient which is calculated by said gradient calculation means; and

line segment image storage which stores the line segment image data produced by said line segment formation means.

49. (new) The image processing apparatus according to claim 8, further comprising means for detecting a level value of the line segment image data for each of the plurality of processing units in the given image.

50. (new) The image processing apparatus according to claim 49, further comprising means for determining a concentration of level values in a processing region.

51. (new) The image processing method according to claim 31, further comprising calculating a magnitude of the level gradient of each of the plurality of processing units in the given image data; and

producing the line segment image data to include a level value corresponding to the magnitude of the level gradient.

52. (new) The image processing method of claim 51, further comprising detecting a level value of the line segment image data for each of the plurality of processing units in the given image.

53. (new) The image processing method according to claim 52, further comprising determining a concentration of level values in a processing region.

54. (new) The inspection apparatus of claim 37, wherein the means for calculating determines a magnitude of the level gradient of each of the plurality of processing units, and produces line segment data including level values corresponding to respective magnitudes of the level gradient.

55. (new) The inspection apparatus of claim 54, wherein the means for detecting recognizes coordinates for all processing units on each line segment and calculates a level value held by processing units in a processing region.